REMARKS

This amendment is responsive to the Office Action of August 29, 2008. Reconsideration and allowance of **claims 3, 5-13 and 17** are requested.

The Office Action

Claims 1, 2, 5-8, and 11-16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Chalana et al. (U.S. Patent No. 7,158,692) in view of Paragios et al. (U.S. Patent No. 7,079,674).

Claims 3, 4, 9, and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Chalana et al. (U.S. Patent No. 7,158,692) in view of Paragios et al. (U.S. Patent No. 7,079,674) further in view of Zahalka et al (U.S. Patent No. 6,385,332).

Claim 13 was rejected under 35 U.S.C. §101 because the claimed invention was directed to non-statutory subject matter.

The Present Application

The present application is directed to a method of segmenting a three-dimensional structure of interest which is contained in an object from a plurality of two-dimensional images when some of the two-dimensional images contain insufficient feature information to identify boundaries of the structure of interest. An image processor determines which two-dimensional images contain the insufficient feature information. A two-dimensional segmentation algorithm is used to identify boundaries of the structure of interest in the two-dimensional images with sufficient feature information. A user manually draws attractors in the form of complete or partial contours to identify the boundaries of the structure of interest in the images which do not contain sufficient feature information. Then, a three-dimensional segmentation algorithm operates on the boundaries identified in the two-dimensional images with sufficient feature information and attractors in the images with insufficient feature information to define the boundary of the structure of interest in three dimensions.

The present application has the advantage of significantly reducing the amount of time of interaction required by an operator since the attractors do not have

to be added to all of the plurality of two-dimensional images, but only to those containing insufficient feature information, where the automatic segmentation fails.

The above description of the present application is presented to the Examiner as background information to assist the Examiner in understanding the application. The above description is not used to limit the claims in any way.

The References of Record

Chalana et al. is directed to a system for image registration and quantitative feature extraction for multiple image sets. Additionally, the system can be characterized as several methods for segmenting and identifying regions of interest within an image. The method for segmenting includes 2D and 3D seedfill, multi-channel augmentation, live-wire contouring, snakes, manual tools, and combinations of those tools.

Paragios et al. is directed to a system and method for segmenting cardiac images, in particular segmenting the left ventricular of the heart using a contour propagation model that integrates visual information and anatomical constraints. The visual information comprises a gradient vector flow-based boundary component and a region component that separates the cardiac contours/regions according to their global intensity properties that reflect the different tissue properties.

Zahalka et al. is directed to an ultrasound segmentation method comprising the steps of automated initial contour identification, followed by application of a geometrically deformable model (GDM). The formation of the initial contours involves the input of a single seed point by the user, and has been found to be insensitive to the placement of the seed within a structure.

35 U.S.C. 101

Claim 13 has been amended as suggested by the Examiner in order to direct the claim to statutory subject matter.

The Claims Distinguish Patentably Over the References of Record

Claims 3, 5-13 and 17 are patentable over Chalana et al. in view of Paragios et al. or Chalana et al. in view of Paragios et al., further in view of Zahalka et al. These rejections are hereby *traversed.*

More specifically, regarding **claim 3**, Chalana et al. does not disclose "automatically determining images of the plurality of two-dimensional images with insufficient feature information for the structure of interest" and "segmenting the structure of interest in the plurality of images by using the attractors." The Examiner refers Applicant to Col. 12 lines 64-67, Col. 15 lines 5-10, Col. 6 lines 31-45, and Col. 17 lines 45-52 of Chalana et al. which discloses an Image Segmentation System which implements 3D and 2D painting, region and edge mode display, and a Shape-Based Interpolation method which is used to rapidly create 3D segmentation from a few 2D segmentations. More specifically, Col. 12 lines 64-67 discloses that the image segmentations are displayed as overlays which are defined by two data structures – a two dimensional stack and a three dimensional volume. Col. 15 lines 5-10 discloses a method where the user can outline a structure by drawing two dimensional contours on images slices in a 3D sequence of images and apply that shape based interpolation to interpolate between the slices. Col. 6 lines 31-45 discloses the advantages of automatic or semi-automatic 2D and 3D image segmentation tools. Col. 17 lines 45 52 discloses using a combination of the segmentation tools so that the 3D structures can be segmented much faster than conventionally utilizing 2D techniques. It is respectfully submitted that Chalana et al. does not teach or disclose automatically determining what two-dimensional images of a plurality of two-dimensional images contains insufficient feature information for the structure of interest. Additionally, Chalana et al. teaches that an expert, while looking at the image sequences, may manually edit the automatically segmented and identified images to correct any errors. Chalana et al. has no such teaching of automatically determining which images of the plurality of two-dimensional images contain insufficient feature information for the structure of interest so that a user may manually drawn attractors in the form of complete or partial contours corresponding to the boundaries of the structure of interest to be placed into the images which do not contain sufficient feature

information in order to save time from having to manually look at the individual images to find images containing insufficient feature information.

Additionally, the Examiner concedes that Chalana et al. does not disclose "manually drawing attractors in the form at least a partial contour of the structure of interest in the images of the plurality of two-dimensional images with insufficient feature information." However, the Examiner asserts that Paragios et al. discloses this step in an variational approach of the segmentation of the left ventricle in MR cardiac images. The Examiner refers Applicant to Col. 1 lines 56-62 and Col. 14 lines 53-56 which discloses a segmentation module which propagates the cardiac contours using the snake model technique. It is respectfully submitted that Paragios et al. does not teach or disclose a user manually drawing attractors in the form of partial contours of the structure of interest in the images with insufficient feature information so that the structure of interest may be segmented. The Examiner also asserts that it would have been obvious to a person of ordinary skill in the art at the time of the invention to use manually drawing attractors in the form of partial contours of the structure of interest because Paragios et al. provides Chalana et al. a method which improves the segmentation performance under the condition that the general model can describe a fairly large portion of the eligible segmentation solutions. The Examiner has provided no evidence or suggestion that it would have been obvious to one of ordinary to combine the snake model segmentation method of Paragios et al. with image segmentation tools of Chalana et al. in order to manually draw attractors in the form of partial contours of the structure of interest in the images with insufficient feature information. It is respectfully submitted that that Paragios et al. and Chalana et al., nor the combination, disclose or fairly suggest automatically determining images of the plurality of two-dimensional images with insufficient feature information for the structure of interest so that a user may manually drawn attractors in the form of complete or partial contours corresponding to the boundaries of the structure of interest to be placed into the images which do not contain sufficient feature information.

Claim 3 further calls for fitting a deformable model to the attractors and computer segmented edges and reconfiguring the model to optimize internal energy.

None of the references suggest using an automatic two-dimensional segmentation and manually placed attractors as the input to a three-dimensional segmentation process.

Accordingly, it is submitted that independent **claim 3** and **claims 5 and 6** that depend therefrom distinguish patentable and unobviously over the reference of record.

Claim 7 calls for an "image processor is adapted to perform the following operation: determining images of the plurality of two-dimensional images with insufficient feature information for the structure of interest." Paragios et al. and Chalana et al., nor the combination, disclose or fairly suggest an image processor which determines which images of the plurality of two-dimensional images contain insufficient feature information for the structure of interest.

Accordingly, it is submitted that independent **claim 7** and **claims 8-12** that depend therefrom distinguish patentable and unobviously over the reference of record.

Claim 13 calls for a computer program for an image processing unit comprising the step of: "determining images of the plurality of two-dimensional images with insufficient feature information to identify edge voxels of the structure of interest." Neither Paragios et al. nor Chalana et al., nor Zahalka et al., nor the combination threof, disclose or fairly suggest a computer program for an image processing unit which determines which two-dimensional images out of a plurality of two-dimensional images do not contain sufficient information for the structure of interest.

Further, **claim 13** calls for performing a two-dimensional segmentation process and a manual attractor indicating process and using the output of these processes in a three-dimensional segmentation process. None of the references, alone or in combination, suggest such a combination of two and three-dimensional segmentation processes. Accordingly, it is submitted that **claim 13** distinguishes patentably over the references of record.

Claim 17 calls for a combination of two-dimensional and three-dimensional segmentation algorithms. The three-dimensional segmentation is based on boundaries designated by the two-dimensional algorithm and manually in two dimensions.

Accordingly, it is submitted that independent **claim 17** distinguishes patentably and unobviously over the reference of record.

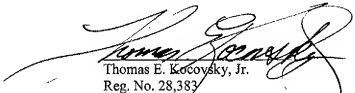
CONCLUSION

For the reasons set forth above, it is submitted that **claims 3, 5-13 and 17** (all claims) distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, the Examiner is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

Fay Sharpe LLP



Thomas E. Kocovsky, Jr.
Reg. No. 28,383
1100 Superior Avenue
Seventh Floor
Cleveland, OH 44114-2579
(216) 861-5582